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Whales in the Mackenzie Delta and Beaufort Sea

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INTRODUCTION

This summary of research results has been written specially for that part of the Berger ^IInquiry dealing with the impact of the oil and gas industry on the environment of the Mackenzie Delta.

The Biology of the Whales

The bowhead Balaena mysticetus L. is a baleen or whalebone whale reaching about 50 ft maximum length. White whales or belugas Delphinapterus leucas Pallas are a medium-sized porpoise. Both are very typical arctic whales having thick blubber for insulation, and no back fin so that they can break ice. The bowhead feeds on small planktonic animals, the white whale, mostly on fish that live under the ice and on squids but also on animals living on the bottom. Of arctic whales only the narwhal, which likes deeper water, is absent from the Pacific section of the arctic.

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Bowhead and white whales migrate into the eastern Beaufort Sea from the west, arriving in May or June through leads in the pack ice. They depart westward again during September in open water. Present numbers of bowheads are not accurately known, but are probably in the low hundreds in this sector of the species' range. Groups of up to 30 have been seen migrating. Numbers of white whales are discussed below. Bowheads spend the summer in oceanic water around Banks Island and off the mainland coast in the neighborhood of Cape Parry and Cape Bathurst. White whales are found in the same waters, but in July many of them move to the warm estuarine water off the Mackenzie River. There is a hunt for white whales in the Mackenzie Delta which for many years has taken an average of about 200 animals per year, but bowheads are not now taken from the Canadian coasts of the Beaufort Sea. (The foregoing is a summary of a paper by Sergeant and Hoek, 1974.)

Both bowheads and white whales are at risk to oil spills when they are in the Beaufort Sea between May and September.

White whales are especially vulnerable to hunting, disturbance, or oil spills from upstream when they concentrate in the Mackenzie Delta in July.

Whale Research

Members of the Arctic Biological Station from its beginning in 1955 have carried out studies on the white whales of the Mackenzie Delta. In 1955 and 1956 the catch was sampled by Dr. J. G. Hunter and students. Since the catch is mainly of selected, large animals, it tells little about the age and sex composition of the whales inhabiting the Delta.

In 1961, 1969 and from 1972 to 1975 inclusive, aerial surveys were carried out in the Delta during July when the white whales concentrate in the Delta, in order to count them and study their distribution. Owing to the high turbidity of Delta waters, not a great deal more can be done than to count the animals and observe their movements; calves for instance are practically invisible. Since 1955 also, observations of whales by other workers have been collected, lately by widely-circulated questionnaire cards.

Work in 1974 was expanded to the offshore region of the Beaufort Sea as part of the Beaufort Sea project, primarily by collection and analysis of records of whales at sea gathered by other investigators in the area. Patrol and census of whales in the Delta in summer, and monitoring of their migration out of the area in autumn, were also intensified.

Earlier objectives were to obtain a knowledge of the basic biology of the animals. Objectives have gradually changed to consider the effects on whales of the major human activities in the area, identified as Inuit hunting and the oil and gas industry. Inuit hunting, as mentioned above, is maintained at a steady level. The activities of the oil and gas industry have expanded from on-land wells to increasing numbers of exploratory wells in shallow water drilled from artificial islands. Recently a few proposed structures in deeper water have been planned and in connexion with these wells a scenario of an oil spill in deep water has been provided (Milne and Smiley, MS 1975.) While the risks of such a spill cannot be assessed, its possible impacts on whales have been considered at each season. A gas pipeline is also proposed

to cross the western portion of the Delta in shallow water.

Parallel with our studies, studies by F. F. Slaney and Co. Ltd., for Imperial Oil Ltd. from 1972 to 1975 inclusive have reinvestigated the basic biology of white whales and have studied the possible effects of island building in the Delta on their activities. These studies are well summarised in Slaney MS 1975.

The area of this study includes the eastern Beaufort Sea from the Alaskan border to Amundsen Gulf and from Banks Island to the mainland coast. Most frequent observations were made from Herschel Island, along the coast of the Mackenzie River and the Tuktoyaktuk Peninsula, to Baillie Islands and Franklin Bay.

Which Part of the Delta is Interesting to the White Whales?

For the purposes of this section we have divided the Delta into three more or less equal-sized parts, the western from Shingle Point to Garry Island; the central from Garry Island to Pullen Island and the eastern from Pullen Island to Toker Point east of Tuktoyaktuk. (Areas west and east of but outside the Delta as so defined may contain some numbers of white whales in July, but are not further considered for the purposes of this section.)

Data for 1961 showed few white whales and may have been incomplete.

In 1969 and following years more than 50% of the white whales were in the western part of the Delta, west of Garry Island, during July (Table 1, Figures 1 and 2). This was true regardless of whether the survey was conducted early or late in the month. Total numbers counted (including some repeat counts) ranged from 525 to 6065,

in the Delta as a whole; of these, 500 to 3700 were in the western part of the Delta. Maxima elsewhere were: in the central part of the Delta, 625, in the eastern part, 2065. There were no trends available in this period.

Thus the western portion of the Delta is the most important to whales.

The most probable explanation of this finding is that the whales concentrate where the water is warmest. Figure 3 shows the temperatures during a survey in July, 1973 by the Arctic Biological Station. Highest temperatures were found in the western portion of the Delta. This is with little doubt related to the volumes of water carried by the channels. Two major channels flow into the western portion, Shallow Bay, carrying the greatest volume of water, one major channel flows out into Kugmallét Bay in the eastern portion and the smallest channel into the central portion, near Kendall I. (Figure 3).

Studies of Slaney (1975) confirm that the greatest and most consistent concentrations of white whales are found in the western part of the Delta (Figures 4 and 5).

Studies elsewhere (Sergeant and Brodie 1969, 1975) have found that calving always occurs in warm water, at about 10°C or above. Probably therefore these major concentrations are calving concentrations.

The Biology of White Whales in the Mackenzie Delta

Not very much is known about the biology of white whales in the Mackenzie Delta. This is because hunting there is selective of large, adult animals, mostly males, so that we do not know the composition

of the herds from the catches. Secondly, the estuary is very burbid with silt so that we cannot see details of the herds from the air; only the white adults are conspicuous and not the small brown calves or grey, in-between animals. We have to round out our knowledge from other parts of the arctic where studies have been made (Sergeant and Brodie 1975). White whales give birth to their calves during the summer. In areas such as western Hudson Bay and Lancaster Sound, we have been able to determine that concentrations of white whales in rivers are associated with calving, since we have found many white adults (of both sexes) in these situations with newborn calves during just this calving period. Some of the rivers are very small and could not be used for feeding. Animals taken in river mouths rarely have anything in their stomachs compared with animals taken along coasts away from rivers. In the Mackenzie River delta also few animals have food remains and most of the remains are the hard parts of squid taken at sea, very few animals having fresh remains of river fish. Only one month or less is spent by the white whales in the Delta out of 4 months in the Beaufort Sea each year. As the animals leave the Delta in July or August small calves can be seen among them. All this evidence leads us to suppose that the major concentrations of white whales in the Delta are concerned with calving and not with feeding. There are no other major rivers in the neighbourhood of the Mackenzie, and of all the rivers in the Canadian part of the Beaufort Sea no others are known to us that have whale concentrations in July as the Mackenzie does. (Once, two rivers in northern Banks Island each had concentrations ranging from a few hundred to a few thousand.) In 1969 and from 1972 to 1973 we have constantly found several thousand animals in the Mackenzie Delta, and by using the highest figure obtained,

we have a minimum estimate of about 5000 white whales that reach the eastern Beaufort Sea each summer. The real total may be somewhat higher, depending on the (unknown) number of whales that remain dispersed in the Beaufort Sea in July, which we have not tried to census.

Effects of Disturbance on White Whales

Studies elsewhere in the arctic have shown that white whales can tolerate human noise and activity. Such activity for instance takes place at Churchill docks, Manitoba and white whales constantly pass and repass this site during the summer months.

However there is some evidence that calving concentrations are more sensitive to human disturbance. Thus, the number of whales at Churchill, Manitoba, is quite small (ca 800) in summer as compared with the Seal River (ca 1500 whales) about 30 km to the north. Yet the Churchill River is much bigger than the Seal River (Sergeant, 1973). Many of the whales at Churchill are feeding off the mouth of the river, on a sea fish, the capelin, whereas the whales at Seal River are concentrated in the shallows where there can be few or no sea fish. Animals driven ashore at the Seal River were found to have newborn calves with them. We surmise that the Churchill River was once a good calving area, but that with the settlement at Churchill, the development of human activities drove away calving animals to such undisturbed sites as the Seal River, leaving mostly the animals exploiting the richer feeding at the mouth of the Churchill River.

At Cunningham Inlet, in Lancaster Sound, a concentration of about

1000 white whales is found in July-August at the mouth of a small warm stream and there are a number of such sites in Lancaster Sound. This concentration contains a lot of newborn small calves. We found this concentration to be very sensitive to waterborne sounds. A stone thrown upstream, for example, caused them to panic. Low flying aircraft also caused disturbance which has not been quantified. However, white whales must be much more sensitive to waterborne than to airborne sounds, judging from their behavior..

Studies of human disturbance on the white whales in the Delta have been correlations only. In the eastern part of the Delta, there is a considerable amount of disturbance associated with canoe noise, and the hunting itself, yet considerable concentrations of whales exist. In the central part of the Delta, where for the most part island building has taken place, there are no large concentrations, but transient groups of whales, so no real test is possible. As far as our observations go, island building activity disturbs these small groups of whales to a distance of perhaps half a mile to a mile, but precise observations are desirable as discussed below. In the western part of the Delta, where the biggest herds of whales have occurred since 1969 inclusive there has to date been very little human activity.

Effects of Oil on White Whales

There is little knowledge of the effects of oil on whales since they are not easy to study experimentally. In the Santa Barbara, California oil spill of 1969 strandings did not increase, i.e. there was no unusual death rate of whales detected, and whales probably avoided the oil spill (Brownell 1971).

The Santa Barbara episode occurred in open water. In the Beaufort Sea, most oil spills would occur when the amount of open water is restricted. Whales might not have much freedom of manoeuvre if they could not avoid the oil, and could receive oil fouling on the skin, in the respiratory tract, and in the digestive tract. Experimental work on ringed seals using a light crude (Norman Wells) has shown few ill effects due to ingestion of the crude (Smith and Geraci, 1976). Without knowledge of the nature of oil that might leak into the sea, the thickness of it on the water and without experimental studies on whales, I am unable to draw any firm ideas of what might happen to whales in the event of an oil spill. I am sure that marine mammals would avoid oily surface water if they could. An upstream oil spill if severe would I think displace seaward a group of whales. However a group of whales with small calves would be unable or unready to move into the cold oceanic water until the calves reach a few days or weeks of age and have put on an insulating blubber layer. Before that, they would lose heat and die in the cold water.

Further Research Needed

We hold no strong views on whether more precise information should be obtained or not on the reaction of whales to water-borne sound. On the one hand, such information clearly could better quantify conclusions drawn above. On the other hand, any such research would have to be done in the field, because it cannot be done in any "laboratory" situation. Any such research, therefore would involve some disturbance to whales in its own right.

Two levels of research could be envisaged. Both should be done by investigators qualified in bioacoustics, preferably those of whales. These researchers should have access to quantitative information on the sound levels and frequencies produced by all types of oil and gas exploitation, particularly those produced by compressors in oil or gas lines.

- (a) Passive listening. The investigators would proceed to a variety of exploration equipment in the Mackenzie Delta and monitor all water-borne sounds in their vicinity. At the same time they would observe the distance of displacement of white whales from these areas of noisy activity.
- (b) Experimental noisemaking. By means of a sound simulator placed near a herd of calving white whales, anywhere in arctic Canada, the investigators would observe noise levels which disturb these concentrations, and relate their findings for example to expected noise levels from an underwater gas pipeline in shallow water with a shore based compressor.

Clearly the second type of experiment would, by itself, involve much more disturbance. It is the opinion of the authors that the first (passive listening) is more obviously justified than the second, if more precise data are judged to be needed, because the investigator becomes so much part of the problem in the second type. Such information is not being gained at the present time either by governmental scientists or by the oil and gas industry.

Monitoring of distribution and numbers of whales should be continued.

Recommendations

With such incomplete knowledge, what action can be recommended?

We believe that it would be prudent to take action which would prevent the calving animals in the Delta from being subject to the possibility of disturbance throughout the whole Delta simultaneously. That is, we believe that a sanctuary or reserve should be set up in the western part of the Delta, where the main mass of whales occurs in July, somewhat as shown in Figure 2. This reserve should be totally free from all disturbance including hunting, construction of artificial islands and of a gas pipeline. The area of such reserve should be the same as or greater than the area of the main mass of the whales found in the western area of the Delta in most years (Figures 4 and 5). Alternatives that have been suggested are: firstly, that island construction should be suspended in summer. This seems to us unrealistic, since the majority of islands are constructed with dragline, suction dredge and barge, or finished thereby, and are most cheaply supplied by barge for construction of superstructures. A second alternative is that islands could be set at a considerable distance apart and that wells could be drilled laterally. In spite of this suggestion we think that such practice--the growth of islands throughout the Delta--if unchecked will lead to the possible result that the whales will leave the Mackenzie Delta to attempt to calve elsewhere. We cannot see any alternative rivers in the neighbourhood of the Mackenzie that could receive a large number of whales. None receive them now except the Mackenzie in July. The area of Liverpool Bay and the Anderson River mouth receives whales in late July, after they have left the Delta. Probably this area opens later and the whales

would have to postpone calving, which is possible to such sea mammals. However the warm water available is very small for such a large number, 5000 animals, and the variety of oceanographic conditions from season to season could permit ice to close such a small river off in some years. By contrast, in the Mackenzie Delta the whales have a choice of the western, central or eastern side according to ice patterns in July.

It may seem rash to argue strongly for a firm reserve or sanctuary in the absence of sufficient hard data on the effects of disturbance on whales. However, all experience with sea mammals points to the need for prudent timely action. Thus, in the east coast harp seal fishery enough preliminary research was available to justify international action by Canada to initiate controls on the fishery in 1952. This action, which would have maintained a steady fishery, was not taken. Only in 1961, and slowly up to the present, have increased controls been placed on the harp seal fishery at the cost of hard negotiation with other nations and with the domestic fishery, a declining fishery and much cost and loss of prestige to Canada.

We maintain that a parallel applies here. The population of white whale which calves in the Mackenzie is virtually the whole of the population in the Beaufort Sea. We postulate that simultaneous oil and gas activities throughout the whole Delta in July each year could so disturb the whale herd that they would be unable to reproduce successfully. In time, the herd would die out. If we wish to maintain the herd, we must initiate measures now which we can be certain will allow its successful reproduction annually. Remedial measures would be more costly in every way.

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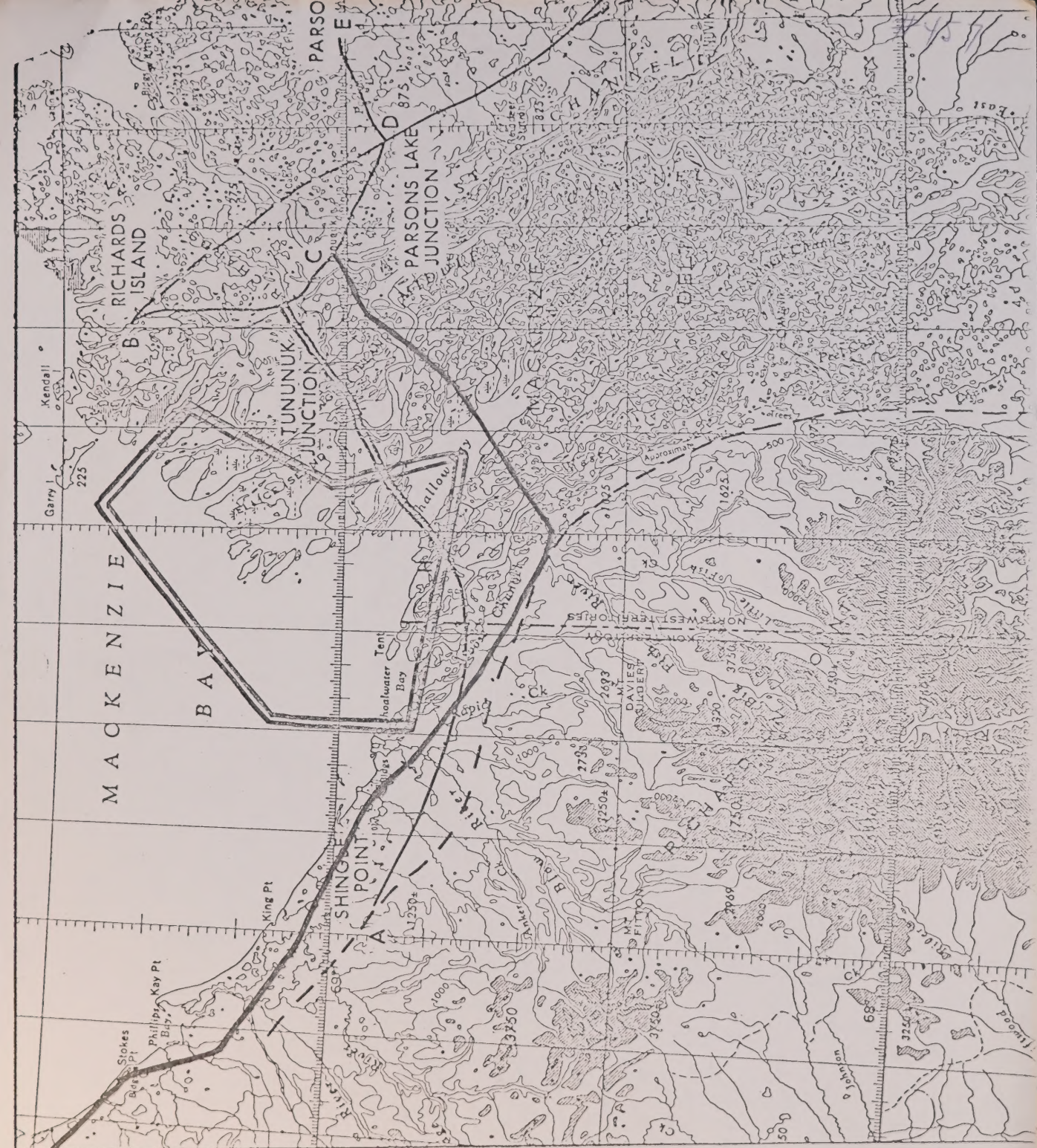
Table 1. Numbers of white whales counted in different parts of the Mackenzie Delta in different years, and numbers of artificial islands (minimal). (Repeated counts of the same whales inflate total numbers present.)

<u>Area of Delta</u>	<u>Western</u>	<u>Central</u>	<u>Eastern</u>	<u>Total</u>	<u>No. of Is.</u>
<u>Year</u>					
1961	---	95	25	120	0
1969	500	25	---	525	0
1972	3125	25	650	3800	1
1973	1500	500	1000	3000	2
1974	3700	300	2065	6065	4
1975	3275	625	575	4475	7
Arithmetic					
mean percent	60.2	20.2	19.6	100.0	

Curriculum vitae

Dr. Sergeant studied zoology, botany and geology at Cambridge University, U.K., majoring in zoology in 1948 and taking his Ph.D. in 1953. Since 1951 he has been with the Fisheries Research Board of Canada, now part of the Fisheries and Marine Service of Environment Canada, and has studied the biology of the great whales, harp and hooded seals, and the arctic whales--white whale, narwhal and bowhead and their management. Dr. Sergeant visited the Delta in August 1961 visiting Inuvik, Aklavik, Shingle Point and Kendall I. and travelling by aircraft and river boat.

Mr. Hoek joined the Arctic Biological Station in 1966, coming from Macdonald College, Que. where he worked in agriculture and entomology. He has visited the Delta in 1968, 1969, 1972, 1973, 1974 and 1975, carrying out surveys of whales and studies of native peoples' whaling. He is presently studying French.



== Approx. boundaries of White Whale
Sanctuary proposed by Sergeant & Hock.

— Barry route (11/2/16)

